

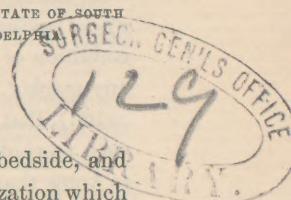
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## EXPLANATION OF A SIMPLE METHOD FOR THE DIAGNOSIS OF ORGANIC VALVULAR DISEASES OF THE HEART.

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AFTER a prolonged study of diseases of the heart at the bedside, and as a teacher of clinical medicine, we have arrived at a generalization which is of great practical use, and which we have taught to classes for many years. From a careful examination also of the principal authorities no flaw can be detected in the very brief table, or formula, which embodies the generalization. It is characterized by exceeding simplicity, it is competent to the unravelling or interpretation of every uncomplicated case of valvular disease—for its merits are intrinsic, being based upon the relations existing between the mechanism and functions of the organ. The table is of instantaneous applicability and can be used by any one.

With our own experience of the difficulty of retaining at all times in the mind the structure, complex operation and functions of the several chambers and valves of the heart, and the nature and cause of the modifications of the sounds they give forth when diseased, we will make no apology to our learned friends, whilst endeavouring to present a clear and simple exposition of the subject, for the statement or repetition of an occasional truism, or a very elementary and well-known fact. The heart, as every one knows, is a complicated machine of exquisite construction, with four chambers and two sets of valves—which sometimes works for a century without repair; yet its mechanism and functions as a great receiving and driving engine—in its healthy action as well as for all purposes of the pathologist—can be grasped and understood by the mental eye if close attention be given to the subject. This must be attained as a preliminary step by any one who pretends to pronounce upon its pathological changes. Let any one attempt to explain all this to others, to a class of students for example—specially those who are not thoroughly grounded in the anatomy and physiology of this viscus—and he will soon know how difficult is the task, how confusing often becomes his efforts at description, how fugitive is the impression produced, and how few are enabled to apply practically what they have even thoroughly understood.

Diverse and diametrically opposite operations have to be appreciated and retained at the same time in the mind, and, as in the study of descriptive geometry, the imaginative faculty also has to a certain extent to be called to aid our comprehension.

We will make no allusions in this paper to hypertrophy, dilatation, pericarditis, or other diseases of the organ.

It is almost needless to say that the first effort of one who is desirous of knowing whether the valves and orifices of the heart are diseased is, obviously, to notice if there be any *derangement*, *aberration*, or *change* from the *normal* sounds! He takes care to listen at the *base* and at the *apex*, paying *separate* attention to each point respectively; and also to the condition of the right and the left cavities,—in order if he does discover any *morbid* sounds (a modification of the natural being always a *morbid* sound), that he may isolate and designate the *derangement* or *lesion* which such *morbid* sound surely indicates. It simplifies the process very much to know that far the greater number of endocardial lesions or injuries (it is needless to give the figures) are found in the *left* cavities. He should keep in mind also that the structure of the valves or curtains at the *base* of the heart (the semilunar or sigmoid valves of the aorta and pulmonary artery) are analogous in shape, and act similarly and simultaneously. They are placed at their respective gateways with similar intent; they close and open, give ingress and egress to the column of blood synchronously. The same is true of those at the point or *apex* (the bicuspid or mitral, and the tricuspid). These, placed between the left and right auricles and ventricles respectively, differ essentially in form and structure from those at the base of the organ,—but they resemble *each other* in their general shape; *they* also open and close simultaneously, and perform analogous functions with each other in the economy of the organ. So, in making a diagnosis in the case of a heart supposed to be diseased, we address our examination to, and fix our mind upon these *two sets* of valves separately, to see if any of them are diseased, and if so, to note: both what is the nature of the change which exists in their own structure, and what modifications have been produced by their alteration of form upon the *orifices* which they close and open. This essential method of procedure (coupled with the statement made above regarding the very marked *infrequency* of diseases of the right cavities), already greatly simplifies the study of the diseased valves. It is practised even by the novice in such inquiries; and when one is seen examining the heart at random—regardless of the above rule, it is clear to the looker-on that he has not mastered the first horn-book lesson upon the subject,—and that it is impossible for him to form any accurate conclusions. He may know that the organ is diseased, but he cannot tell where the injury is.

Besides this, whoever is desirous of investigating a case of heart disease, must have in addition to his anatomical knowledge, fully and clearly in

his mind the whole action and re-action in the cavities of the organ during its systole and diastole; he must know when and where the current is flowing out, and when and where its passage is estopped—whether at the back-gates, or at the front-gates, and conversely. For, it is when those muscular and tendinous strings and cords at the apex, or those semilunar curtains at the base—which open and shut these orifices, are defective, *i. e.*, when they close imperfectly, are *deficient* (“*insufficiency*”—and permit regurgitation when they should not; or when by fibrinous or other deposits upon the valves the orifices are *narrowed* or *roughened* (“*stenosis*”), and thus *obstruct* the forward flow, and give rise to abnormal, morbid sounds—it is the consideration and explanation of this problem which is his object in every case which becomes the subject of critical inquiry.

It is essential then, that besides a full appreciation of the currents and checks in the incessant working of the organ—the onward flow and the movements of the fleshy barriers which suddenly and rhythmically arrest the flow,—he should first *know* the normal *healthy* sounds, in order to detect the slightest *deviation* from them; and he should localize these deviations—for they are necessarily *morbid* sounds, and *indicate diseased valves*.

It being necessary then for the observer to know the cause and rationale of the normal sounds, we will state them. It is pretty well agreed that the first sound (represented by the word “*lubb*”) is synchronous with the *systole* of the organ, and is owing to one or all of three causes: *viz.*, the contraction of the muscular ventricles, the sudden closure of the auriculo-ventricular valves which prevents the blood from regurgitating into either auricle, and the impulsion of the heart against the walls of the chest. At this moment a column of blood is driven forcibly through the aorta and pulmonary artery, and the auricles are silently filling with blood from the valveless *venæ cavae* and from the pulmonary veins.

That the second sound (represented by the word “*dup*”) is synchronous with the *diastole* of the organ, and is due to the shutting up of the aortic and pulmonary artery semilunar valves. The closure of these valves at this moment prevents the regurgitation of the blood from the aorta and pulmonary artery into the ventricles—when during the diastole of the ventricles these are being filled from the auricles.

During the prolonged interval of rest following (which is equal in duration to the 1st, and twice the length of the 2d sound), we may suppose that the auricles are still silently pouring their contents into the ventricles—the portals of which are now wide open. During this period of apparent calm the heart—endowed with a high degree of nervous energy derived from the cardiac ganglia of the sympathetic and the pneumo-gastric, wound round and enwrapped with bundles of concentrically interlaced muscular fibres, layer upon layer as if encased with triple steel, and indeed the very “cunningest pattern of excelling nature” as respects

endurance, strength and force—is preparing, like a wild animal gathering for its spring, for the next systolic paroxysm when its contents will be forced into the delicate meshes of the lungs, and be driven through the finest capillary tubes in the remotest tissues of the organism.

We will confine our attention at present whilst attempting to describe the *morbid* sounds and the lesions they indicate, to what takes place in the left cavities,—for whatever is true of the left is true of the right so far as the circulation of blood is concerned—and we will simplify matters much by so doing.

Now with the first sound (systolic) the blood is being driven through the opened aortic orifice—at which moment the back-gate (the mitral or bicuspid) is shut. So, if we have a deranged or abnormal *first sound* heard with the greatest intensity at the *base* of the heart (and it is not a soft, inorganic, anaemic murmur, which is owing to the thinness of the blood, and which is out of the present question), there is necessarily a narrowing (stenosis) or roughness of the aortic orifice,—an obstruction there by vegetations, atheroma, or other morbid condition preventing the natural flow of blood through the aortic orifice, and deranging or modifying the natural sound.

Hence a deranged first sound at the *base* of the heart indicates *narrowing* or *obstruction—stenosis*, in other words, of the *aortic valves*.

But suppose this abnormal, morbid *first sound* has its greatest intensity at the *apex* of the heart. It must be owing to this fact: that the back-gate has a chink in it—it is more or less open, in place of being tightly closed as it should be; the column of blood instead of meeting with the normal resistance of the closed and perfect mitral valve (bicuspid), in order that it may be propelled through the aorta and reach the utmost boundaries of the tree of life—it is leaking back through the defective portals of the mitral,—it is regurgitating into the left auricle; and it gives out to the ear placed over the apex a morbid murmur, or noise, more or less *prolonged*, in place of the ordinary normal first sound (represented by the word “lubb”). The valve is necessarily defective as a flood-gate; it is incapable of close shutting up; that its mechanism has become defective is indisputable, and we pronounce positively upon the subject.

So a deranged first sound at the *apex* indicates *insufficiency* of the mitral valve, caused by vegetations, or other result of endocarditis.

We have now disposed of derangements or abnormalities (which are always *morbid*) of the first sound of the heart both at the base and apex. They indicate nothing else but what we have said that they do.

Let us now proceed to pronounce upon derangements or abnormalities of the second sound (diastolic), should they be noticed either at base or apex: If the second sound is deranged, its greatest intensity or disturbance being at the *base* of the heart, it must necessarily indicate the exact opposite condition to that which we stated that derangements of the first

sound indicated—for exactly the reversed condition of affairs is taking place ; the semilunar valves are shutting now—they were open then. The valves at the base are acting directly contrary to those at the point also ; when one set are shut the other set are open.<sup>1</sup> During the second sound we know that the aortic valves are closing, in order to keep the blood temporarily from flowing backward into the left ventricle (which is a reservoir of supply). So if there is a morbid second sound (diastolic) at the base the valves of the aorta are *insufficient*. The front-gate has not closed tightly, there are vegetations, hardened *plaques* of fibrine, or bone, or cartilage, which interfere with the integrity or pliancy of the delicate curtains which form this front flood-gate ; and the column of blood in the aorta instead of remaining quiescent for a moment, as it should and does do in a state of health, some of it regurgitates into the dilating ventricle and gives a deranged, morbid second sound.

Therefore a morbid *second sound* at the *base* indicates *insufficiency* of the aortic valves.

Now suppose the deranged, morbid second sound has its seat of greatest intensity at the *apex*, instead of being at the base ; it is very plain then that the back-gate, the mitral or bicuspid orifice, is narrowed, obstructed (stenosis), and the blood in passing through makes a noise. Because during the second sound (diastolic) the mitral orifice should be wide open to allow the blood from the auricle to enter noiselessly and fill up the ventricle, otherwise there would be no supply for the next systolic effort of the heart. If the orifice is obstructed or narrowed the blood does not pass through noiselessly as in a state of health ; the second sound is abnormal ; there is a murmur.

A disturbed second sound at the *apex* indicates then *stenosis* of the mitral orifice.

Our table now is very easily constructed, and being based upon eminently natural and scientific foundations, namely, the physical laws of the heart's structure, functions, and actions, it must serve as a ready method enabling us, or any one else—even the most uninstructed,—to make a diagnosis of all the uncomplicated organic diseases of the valves at the orifices of all the chambers of the heart. As it is necessarily true and correct, and though it may seem very simple, it requires no thought to apply it to any case before us ; nor that we should at the time of applying it understand *why* it is correct.

<sup>1</sup> A third well-known relation may very properly be stated here to complete the sketch of these antagonisms and contrasts. This regards the cavities of the organ. The ventricles and auricles are synergistic only with themselves ; when the former are contracting the latter are dilating, and *vice versa*.

The formula and the order of the words to be recalled are:—

*Stenosis.*

*Insufficiency.*

*Insufficiency.*

*Stenosis.*

For example:—

At the base	A deranged 1st sound indicates <i>Stenosis</i> of the aortic, or pulmonary artery valves. A deranged 2d sound indicates <i>Insufficiency</i> of the aortic, or pulmonary artery valves.
At the apex	A deranged 1st sound indicates <i>Insufficiency</i> of the bicuspid, or of the tricuspid valves. A deranged 2d sound indicates <i>Stenosis</i> of the bicuspid, or of the tricuspid valves.

All we have to do is to memorize these words in their order, as a formula, to elucidate at the bedside the valvular diseases of the heart. Observe what sounds are deranged at the base, then at the apex, and pronounce accordingly. Of course the known relative positions of the four valves must guide us in deciding which of the two valves at the base, or at the apex, the abnormal murmur proceeds from, so as to distinguish between the valvular derangements of the right and left heart.

Of course Hoppe and Niemeyer, Skoda, Tanner, and Da Costa, the Flints, as well as D. H. Tucker,<sup>1</sup> and David Wooster,<sup>2</sup> in their admirable medical journal articles, and T. G. Thomas in his chart,—all these and other writers, not only present in the main and with greater or less lucidity and clearness the principles and facts referred to above; but none of them, we believe, have isolated and placed in so compact and simple a shape—to be readily remembered and used—the generalization we have formulated above.

We would like to enrich this paper by adding some selections, in the shape of aphorisms for practical use, from the copious abstracts we have made during many years past from different authorities, specially those culled from Hoppe's work; for we feel sure that their reproduction here would be of use to those who are desirous of perfecting their means of diagnosis,—but want of space forbids.

<sup>1</sup> Gaillard's Richmond Med. Journ., Jan. 1868.

<sup>2</sup> Canada Med. Journal.



